PRICE $2.00

Tool #209691

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT®

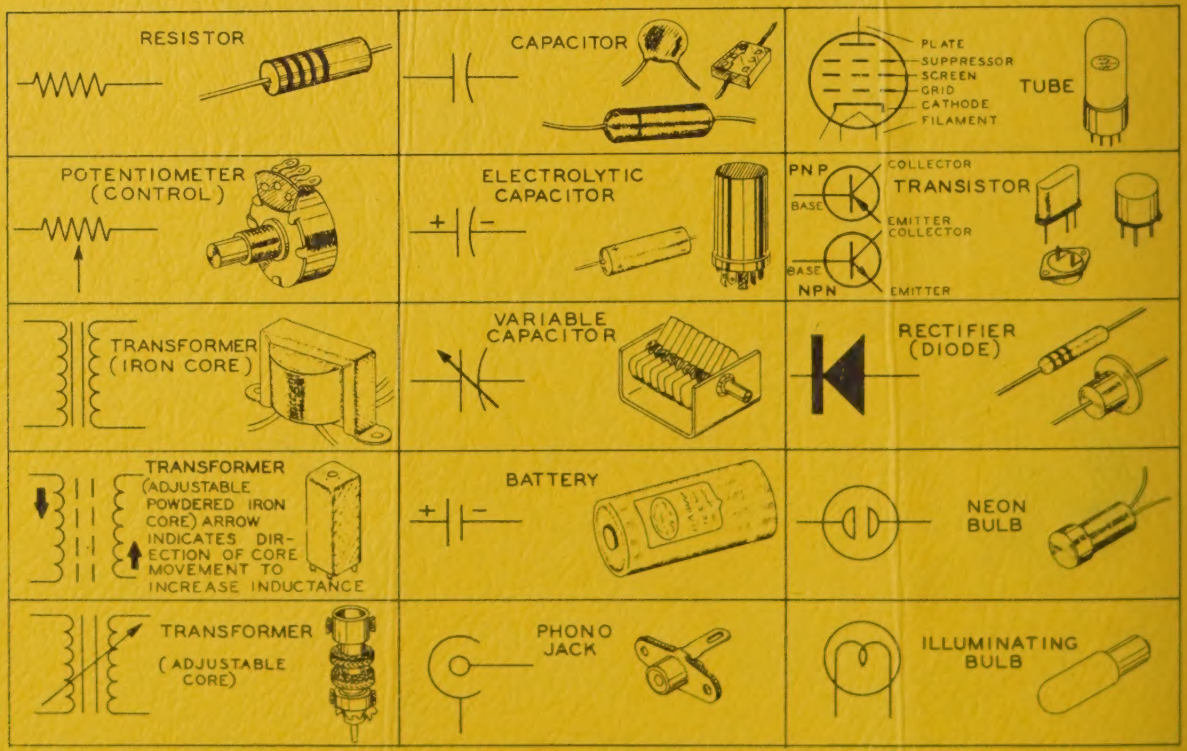
RESISTANCE SUBSTITUTION BOX

MODEL IN-37

Copyright © 1967
Heath Company
All rights reserved

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



Continued on Back Cover

Assembly and Operation

of the

HEATHKIT

RESISTANCE SUBSTITUTION BOX

MODEL IN-37

HEATH COMPANY
BENTON HARBOR, MICHIGAN

TABLE OF CONTENTS

Specifications	2
Description	2
Parts List	3
Assembly Notes	5
Step-By-Step Assembly	6
Applications	12
In Case Of Difficulty	13
Replacement Parts Price List	14

5-19-67

SPECIFICATIONS

Range	15 ohms to 10 megohms.
Accuracy	±10% EIA values.
Power Rating	1 watt, all values.
Voltage Rating	500 volts continuous.
Dimensions	6" long x 3" wide x 3" high.
Net Weight	1 lb.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

DESCRIPTION

The Model IN-37 Resistance Substitution Box was designed to provide a rapid and flexible means of determining the resistance values required in electronic circuits.

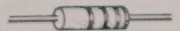
The "shorting type" switches with make-before-break action permit smooth selection of the resistance values without opening or shorting the circuit.

The HI-LO switch makes it possible to switch from one range switch to the other for high or low value resistances. Each resistance value that can be selected is marked by value on the front panel. All values are EIA standards so that resistors of the same values can be obtained.

PARTS LIST

Unpack the kit carefully and check each part against the Parts List. The numbers in parentheses in the Parts List correspond to the numbers of the parts drawings to aid in quick and positive parts identification.

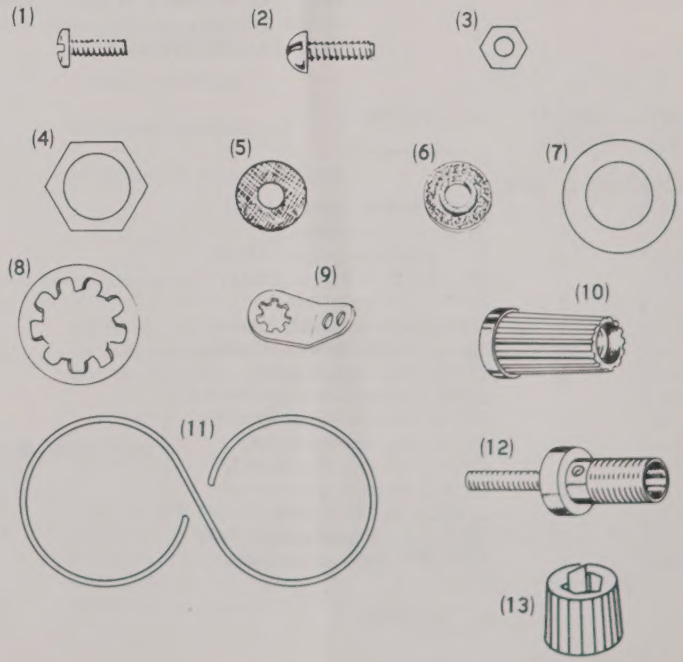
PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS (1 Watt)		
(1) 1-12-1	1	15 Ω (brown-green-black)
1-13-1	1	22 Ω (red-red-black)
1-14-1	1	33 Ω (orange-orange-black)
1-15-1	1	47 Ω (yellow-violet-black)
1-16-1	1	68 Ω (blue-gray-black)
1-17-1	1	100 Ω (brown-black-brown)
1-18-1	1	150 Ω (brown-green-brown)
1-19-1	1	220 Ω (red-red-brown)
1-20-1	1	330 Ω (orange-orange-brown)
1-1-1	1	470 Ω (yellow-violet-brown)
1-21-1	1	680 Ω (blue-gray-brown)
1-2-1	1	1000 Ω (brown-black-red)
1-22-1	1	1500 Ω (brown-green-red)
1-23-1	1	2200 Ω (red-red-red)
1-3-1	1	3300 Ω (orange-orange-red)
1-24-1	1	4700 Ω (yellow-violet-red)

(1) 

PART No.	PARTS Per Kit	DESCRIPTION
Resistors (1 Watt) (cont'd.)		
1-25-1	1	6800 Ω (blue-gray-red)
1-9-1	1	10 KΩ (brown-black-orange)
1-26-1	1	15 KΩ (brown-green-orange)
1-5-1	1	22 KΩ (red-red-orange)
1-27-1	1	33 KΩ (orange-orange-orange)
1-7-1	1	47 KΩ (yellow-violet-orange)
1-8-1	1	68 KΩ (blue-gray-orange)
1-28-1	1	100 KΩ (brown-black-yellow)
1-29-1	1	150 KΩ (brown-green-yellow)
1-30-1	1	220 KΩ (red-red-yellow)
1-31-1	1	330 KΩ (orange-orange-yellow)
1-32-1	1	470 KΩ (yellow-violet-yellow)
1-33-1	1	680 KΩ (blue-gray-yellow)
1-34-1	1	1 megohm (brown-black-green)
1-35-1	1	1.5 megohm (brown-green-green)
1-36-1	1	2.2 megohm (red-red-green)
1-37-1	1	3.3 megohm (orange-orange-green)
1-38-1	1	4.7 megohm (yellow-violet-green)
1-39-1	1	6.8 megohm (blue-gray-green)
1-40-1	1	10 megohm (brown-black-blue)

PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE		
(1) 250-213	4	4-40 x 5/16" screw
(2) 250-9	2	6-32 x 3/8" screw
(3) 252-3	2	6-32 nut
(4) 252-7	2	Control nut
(5) 253-1	2	Fiber flat washer
(6) 253-2	2	Fiber shoulder washer
(7) 253-10	2	Control flat washer
(8) 254-4	2	Control lockwasher
(9) 259-1	2	Solder lug
MISCELLANEOUS		
60-4	1	SPDT slide switch
63-451	2	Rotary switch
(10) 100-16-2	2	Binding post cap
203-415-2	1	Front panel
(11) 213-1	1	Resistor mounting ring
408-11	1	Case
(12) 427-2	2	Binding post base
462-245	2	Knob
(13) 455-50	2	Knob bushing
344-59	1	Hookup wire
391-34	1	Blue and white identification label
331-6		Solder
597-260	1	Parts Order Form
597-308	1	Kit Builders Guide
595-874	1	Manual

PARTS PICTORIAL



ASSEMBLY NOTES

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important, as it may prevent errors or omissions, especially if your work is interrupted.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

When soldering, position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth soldered junction appears. Do not move the leads until the solder is solidified.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP ASSEMBLY

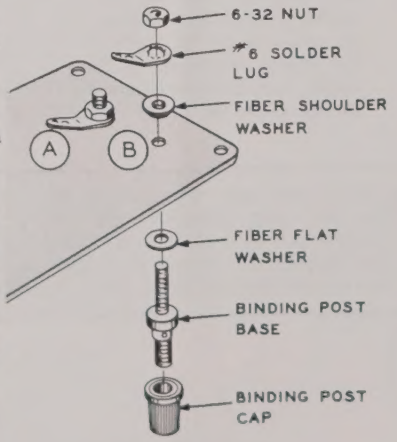
Refer to Pictorial 1 for the following steps.

( ) Mount binding posts at A and B on the front panel. Use the fiber shoulder washers, fiber flat washers, solder lugs, and 6-32 nuts as shown in Detail 1A. Position the solder lugs as shown.

( ) Install binding post caps on the binding posts at A and B.

( ) Mount the SPDT slide switch (#60-4) at location C on the front panel. Use two 6-32 x 3/8" screws.

( ) Look into the edge of each of the two rotary switches and notice the position of the rotor contact. If the rotor contact is not at lug 1, turn the switch shaft with a pair of pliers until the rotor is at lug 1. See Detail 1B.

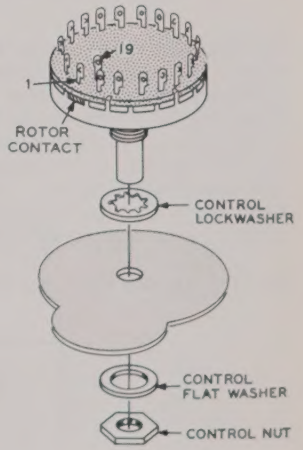


Detail 1A

( ) Mount the two rotary switches at D and E with control lockwashers, control flatwashers, and control nuts. Position lugs 1 and 19 of each switch as shown in Pictorial 1.

The knobs supplied with this kit use knob bushings that provide permanent positive gripping without the use of setscrews.

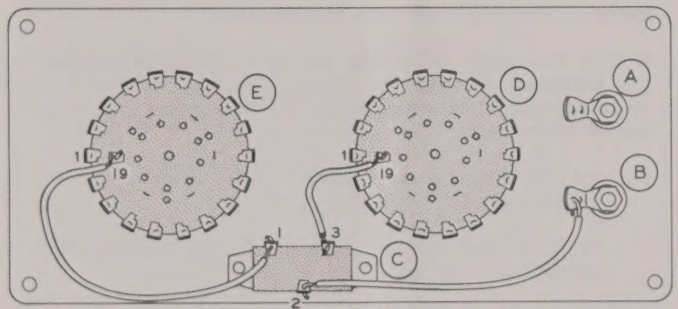
In the following steps you will install a knob on each of the two switch shafts as shown in Detail 1C. Perform these steps carefully, as a knob bushing cannot be removed from a knob once it is fully inserted.



Detail 1B

( ) Push a knob bushing part way onto each of the two switch shafts.

( ) At the switch location nearest the binding posts, line up the pointer of a knob with the 15 K mark on the panel. Then press the knob slightly onto the bushing.



PICTORIAL 1

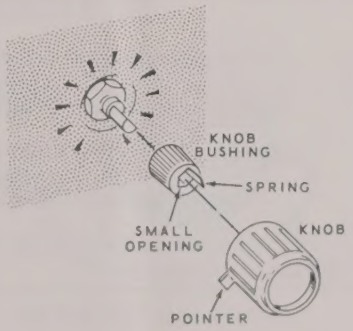
( ) At the other switch location, line up the pointer of a knob with the 15 mark on the panel. Then press the knob lightly onto the bushing.

( ) Turn the knob clockwise to each of the switch stop positions. Check to see that the pointer lines up with each panel marking.

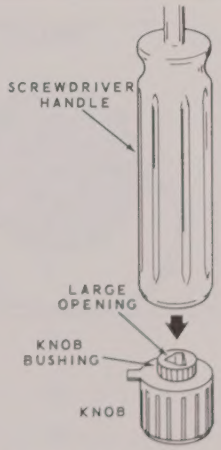
NOTE: Perform the next three steps only if either pointer does not line up at each switch marking.

1. ( ) Turn the knob pointer to a selected marking on the panel.

2. ( ) Remove the knob from the bushing and turn it slightly to line up the pointer with the selected marking.



Detail 1C



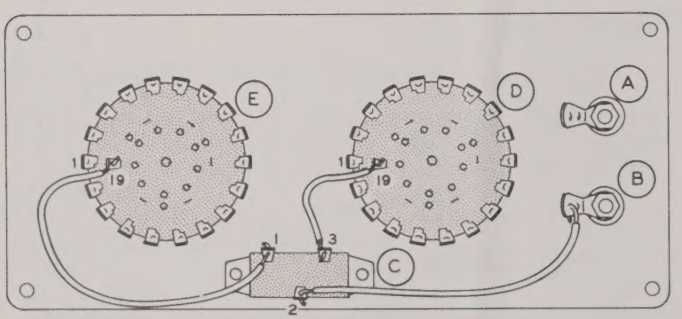
3. ( ) Press the knob slightly onto the knob bushing. Then turn the knob to each switch position and recheck the pointer alignment. If more than a slight error is noticed at either end position, repeat these three steps.

( ) Carefully remove the knob bushing and knob together.

( ) Place tha knob on a table or other hard surface, then press the knob bushing firmly into the knob. Use a towel of soft cloth on the work surface to avoid scratching the knob.

( ) Press the knob and bushing firmly onto the switch shaft.

( ) Repeat the above Knob Installation steps to install a knob on the other switch shaft.



Pictorial 1
(Repeat)

( ) Cut three hookup wires, one 1-1/2", one 3-3/4", and one 3". Remove 1/4" of insulation from the ends of these wires.

( ) Solder a 1-1/2" wire from lug 19 of switch D to lug 3 of switch C.

( ) Solder a 3-3/4" wire from lug 19 of switch E to lug 1 of switch C.

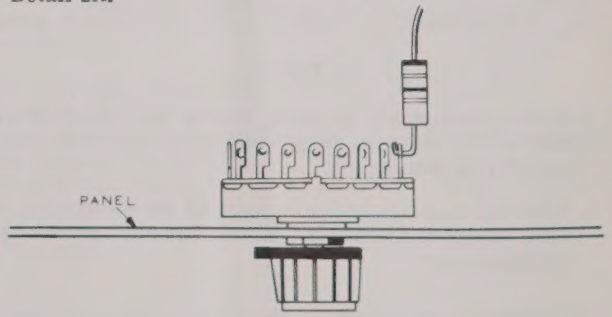
( ) Solder a 3" wire from lug 2 of switch C to binding post base B.

Refer to Pictorial 2 for the following steps.

NOTE: The major portion of the wiring consists of connecting the resistors between the rotary switches and the resistor mounting ring. This wiring should be done as neatly as possible, and as instructed.

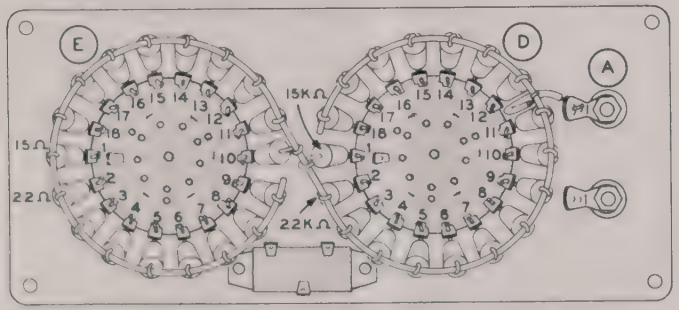
( ) Cut one lead of each resistor to 3/8". The other lead of the resistor should not be cut.

( ) Form a hook in the cut lead of each resistor. Refer to Detail 2A.



Detail 2A

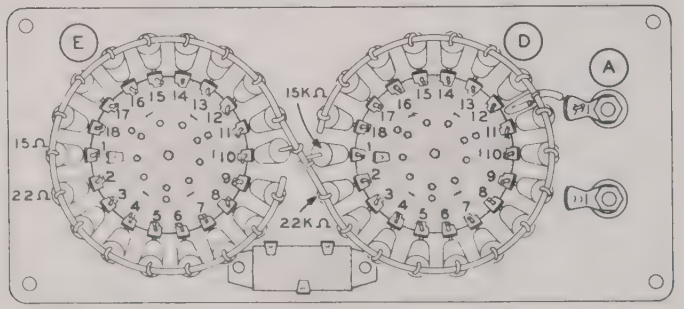
( ) Arrange the resistors in order starting with the lowest value, 15 Ω (brown-green-black) and proceed to the highest value, 10 megohm (brown-black-blue). The resistors are listed in this sequence in the Parts List.



PICTORIAL 2

Connect the resistors to rotary switch E according to the following chart. Position each resistor so that the resistor lead hooks into the switch lug from the outside, then solder. Refer to Detail 2A. The resistor mounting ring will be installed after all the resistors are connected to the switches.

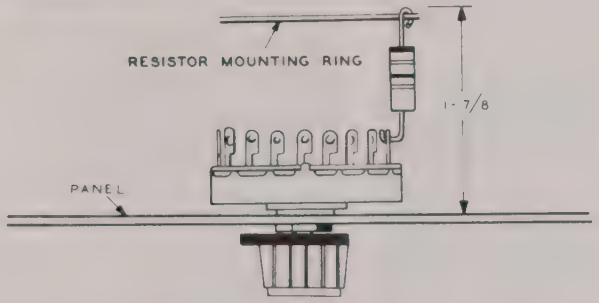
CONNECT A	TO LUG
( ) 15 Ω (brown-green-black)	1
( ) 22 Ω (red-red-black)	2
( ) 33 Ω (orange-orange-black)	3
( ) 47 Ω (yellow-violet-black)	4
( ) 68 Ω (blue-gray-black)	5
( ) 100 Ω (brown-black-brown)	6
( ) 150 Ω (brown-green-brown)	7
( ) 220 Ω (red-red-brown)	8
( ) 330 Ω (orange-orange-brown)	9
( ) 470 Ω (yellow-violet-brown)	10
( ) 680 Ω (blue-gray-brown)	11
( ) 1000 Ω (brown-black-red)	12
( ) 1500 Ω (brown-green-red)	13
( ) 2200 Ω (red-red-red)	14
( ) 3300 Ω (orange-orange-red)	15
( ) 4700 Ω (yellow-violet-red)	16
( ) 6800 Ω (blue-gray-red)	17
( ) 10 KΩ (brown-black-orange)	18



Pictorial 2
(Repeat)

In the same manner, install the remaining resistors on rotary switch D, as follows:

CONNECT A	TO LUG
( ) 15 KΩ (brown-green-orange)	1
( ) 22 KΩ (red-red-orange)	2
( ) 33 KΩ (orange-orange-orange)	3
( ) 47 KΩ (yellow-violet-orange)	4
( ) 68 KΩ (blue-gray-orange)	5
( ) 100 KΩ (brown-black-yellow)	6
( ) 150 KΩ (brown-green-yellow)	7
( ) 220 KΩ (red-red-yellow)	8
( ) 330 KΩ (orange-orange-yellow)	9
( ) 470 KΩ (yellow-violet-yellow)	10
( ) 680 KΩ (blue-gray-yellow)	11
( ) 1 megohm (brown-black-green)	12
( ) 1.5 megohm (brown-green-green)	13
( ) 2.2 megohm (red-red-green)	14
( ) 3.3 megohm (orange-orange-green)	15
( ) 4.7 megohm (yellow-violet-green)	16
( ) 6.8 megohm (blue-gray-green)	17
( ) 10 megohm (brown-black-blue)	18

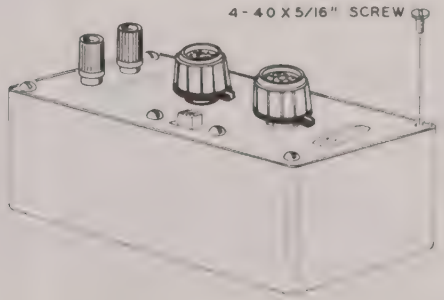


Detail 2B

( ) Slip the resistor mounting ring over the resistor mounted on the rotary switches. The resistors should be placed on the inside of each circle as shown in Detail 2B. The mounting ring should be pushed close to the resistor bodies and the leads bent around the mounting ring to make a good mechanical connection. Cut off the excess resistor lead lengths. Now flow solder smoothly over each joint.

( ) Solder a 2" wire from binding post base A to the resistor mounting ring.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company: this assures you that you will receive the most complete and up-to-date information in return.



PICTORIAL 3

( ) Carefully peel away the backing paper from the identification label. Then press the label into position on the inside of the case.

( ) Refer to Pictorial 3 and mount the front panel in the case with the 4-40 x 5/16" screws. Do not overtighten the screws or you may damage the case.

This completes assembly.

APPLICATIONS

In radio or television service work, the Heathkit Resistance Substitution Box will prove of great assistance in experimentally determining the desired value of a charred or unmarked resistor through temporary substitution. It can also be substituted for any resistor in a circuit so that the value of the resistor may be changed during operation in order to determine the desired resistance value that will provide maximum circuit performance. No attempt will be made to detail all of the various applications; through continued usage many additional applications of the Resistance Substitution Box will suggest themselves to the serviceman.

In laboratory or circuit development work, the Resistance Substitution Box will prove invaluable. The advantages of using several Resistance Substitution Boxes are obvious, as any change in a circuit constant usually requires a corresponding change in some other component. By having Resistance Substitution Boxes connected in the plate, grid, cathode or screen supply circuits, the entire experimental setup can be quickly changed.

Because the Heathkit Resistance Substitution Box kit uses standard EIA values, it is possible to select from your working stock the exact resistor needed for any application. The resistors used are all rated at 1 watt and this rating should not be exceeded in use. The continuous operating voltage rating of 500 volts should be observed to prevent a flashover within the unit.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered properly.

3. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring in-instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

5. An ohmmeter can be used to check the resistance values as the switches are turned to each position. Make sure the knob pointers line up properly with the markings on the panel.

Refer to the Kit Builders Guide for Service and Warranty information.

REPLACEMENT PARTS PRICE LIST

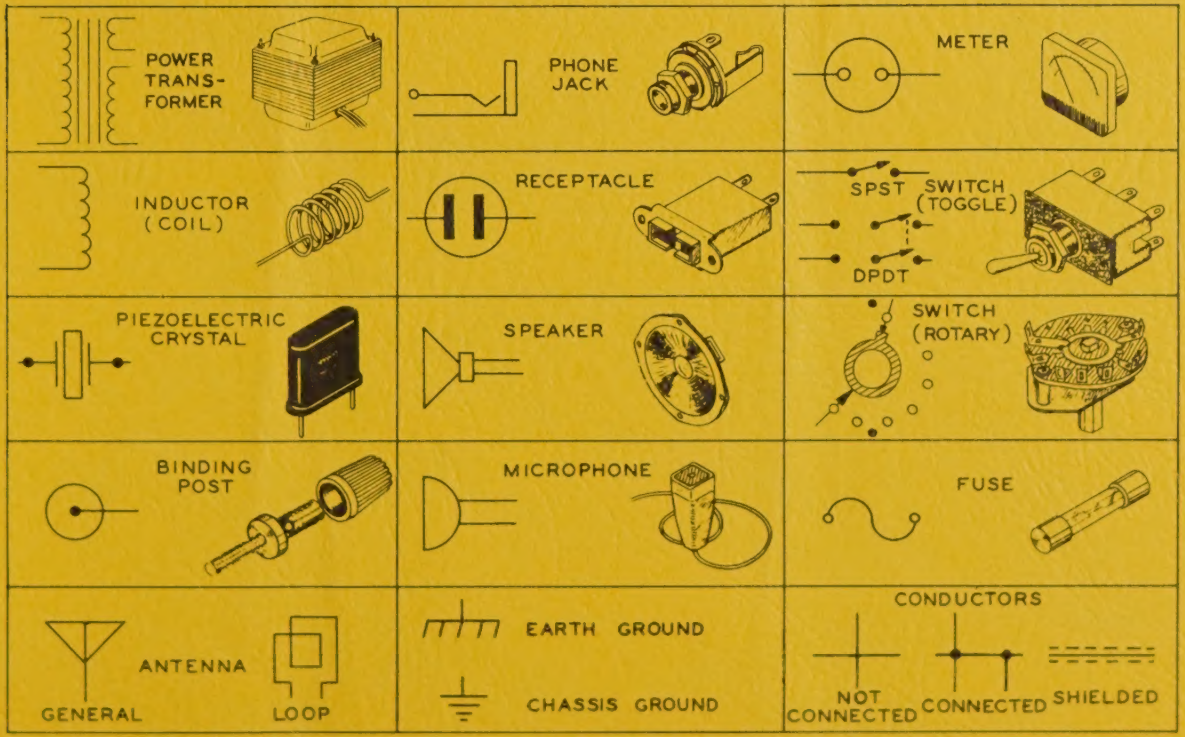
PART No.	PRICE Each	DESCRIPTION
RESISTORS (1 Watt)		
1-12-1	.10	15 Ω
1-13-1	.10	22 Ω
1-14-1	.10	33 Ω
1-15-1	.10	47 Ω
1-16-1	.10	68 Ω
1-17-1	.10	100 Ω
1-18-1	.10	150 Ω
1-19-1	.10	220 Ω
1-20-1	.10	330 Ω
1-1-1	.10	470 Ω
1-21-1	.10	680 Ω
1-2-1	.10	1000 Ω
1-22-1	.10	1500 Ω
1-23-1	.10	2200 Ω
1-3-1	.10	3300 Ω
1-24-1	.10	4700 Ω
1-25-1	.10	6800 Ω
1-9-1	.10	10 KΩ
1-26-1	.10	15 KΩ
1-5-1	.10	22 KΩ
1-27-1	.10	33 KΩ
1-7-1	.10	47 KΩ
1-8-1	.10	68 KΩ
1-28-1	.10	100 KΩ

PART No.	PRICE Each	DESCRIPTION
Resistors (1 Watt) (cont'd.)		
1-29-1	.10	150 KΩ
1-30-1	.10	220 KΩ
1-31-1	.10	330 KΩ
1-32-1	.10	470 KΩ
1-33-1	.10	680 KΩ
1-34-1	.10	1 megohm
1-35-1	.10	1.5 megohm
1-36-1	.10	2.2 megohm
1-37-1	.10	3.3 megohm
1-38-1	.10	4.7 megohm
1-39-1	.10	6.8 megohm
1-40-1	.10	10 megohm
HARDWARE		
250-213	.05	4-40 x 5/16" screw
250-9	.05	6-32 x 3/8" screw
252-3	.05	6-32 nut
252-7	.05	Control nut
253-1	.05	Fiber flat washer
253-2	.05	Fiber shoulder washer
253-10	.05	Control flat washer
254-4	.05	Control lockwasher
259-1	.05	Solder lug

PART No.	PRICE Each	DESCRIPTION
MISCELLANEOUS		
60-4	.20	SPDT slide switch
63-451	2.40	Rotary switch
100-16-2	.10	Binding post cap
203-415-2	.30	Front panel
213-1	.10	Resistor mounting ring
408-11	.80	Case
427-2	.10	Binding post base
462-245	.60	Knob
455-50	.10	Knob bushing
344-59	.05/ft	Hookup wire
331-6	.10	Solder
595-874	2.00	Manual

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Selling prices elsewhere in U.S.A. may be slightly higher to offset transportation and local taxes. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

TYPICAL COMPONENT TYPES



HEATH COMPANY

BENTON HARBOR MICHIGAN

MP MASTER

MA23866

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

595-874

LITHO IN U. S. A.